A DAIRY PRODUCTS DISTRIBUTION FACILITY:

Layout and Operating Methods

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A DAIRY PRODUCTS DISTRIBUTION FACILITY:

Layout and Operating Methods

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SUMMARY

The distribution system for dairy products is changing rapidly. Research has shown that because of high operating costs, many small processing plants are closing while others are merging with larger, more efficient plants (Bureau of the Census, 1970). As a result, the larger plants are required to distribute their products over a much broader area, and distribution costs have increased. Consequently, improved distribution methods are needed to reduce these costs. One method is to build distribution facilities for serving consumers in areas where plants had previously existed but have gone out of business or in newly established distribution areas. This solution is particularly applicable if the distribution costs of the processing plant exceed the cost of building and operating a distribution facility.

This research report provides a detailed description of a model distribution facility, work methods, and labor requirements for its efficient operation and the potential benefits that can be derived from such an operation. The plan shows the location of the main building and the supporting installations on the site. This information can be used as a guide by dairy plant operators who plan to build new distribution facilities.

The distribution facility is rectangular and contains 5,600 square feet of floorspace. It is designed to receive, store, and distribute a weekly volume of 57,000 gallons of fluid milk products, 3,000 gallons of fruit drinks, 10,000 gallons of frozen desserts, and a small volume of miscellaneous products. A cooler, a freezer, and a refrigeration equipment room are located on the first floor, and an auxiliary area is located on the second floor. The site is large enough for expanding the facility to handle a 50-percent increase in volume.

INTRODUCTION

The distribution of fluid milk and other dairy products is becoming a complex and costly operation. Because of vigorous competition, low volume of production, and high cost of operation, many small dairy processing firms either have closed or have been purchased by larger, more efficient firms. Because it is more economical to operate one big plant than to operate several small ones, many large firms have combined their total processing operations at one location to reduce their processing costs. Consequently, the number of firms involved in processing and distributing dairy products has declined approximately 37 percent during the 10-year period from 1958 to 1967.[1] Products are being transported over greater distances to serve consumers in areas where plants have closed and in newly built communities, thereby increasing distribution costs. In an effort to reduce these costs, the trend has been toward building and operating distribution facilities. Some processing plants have been converted to distribution facilities, but many of them are poorly planned and improperly designed. Because of changes that are occurring in the distribution system, the

[1] Plant numbers in the dairy industry 1967, 1963, 1958 Census, Dairy Record, Bureau of the Census, April 15, 1970.

efficiency of operating methods and facility designs must be reevaluated to reduce rising costs.

This report is intended as a guide to dairy plant operators who plan to build dairy products distribution facilities. Emphasis is placed on planning and designing a facility that will maintain maximum efficiency and reduce distribution costs. It contains a detailed description of a distribution facility that uses efficient operating methods and labor practices and cites the potential benefits to be derived from such an operation. A site plan shows the location and arrangement of the main building and its supporting installations.

These plans incorporate the principles of good layout and design and show facility size in relationship to the type and volume of products handled. These plans are general recommendations for building in areas where the cost of distributing products from the processing plant exceeds the cost of building and operating a distribution facility.

ASSUMPTIONS REGARDING THE OPERATION OF A DISTRIBUTION FACILITY

To illustrate principles of layout and methods of operating a dairy products distribution facility, the following assumptions were necessary:

1. The distribution facility will be part of the distribution system of a dairy products processing plant that processes and distributes about 150,000 gallons of fluid milk products and fruit drinks and 25,000 gallons of frozen desserts a week.

2. The facility will handle a weekly volume of 57,000 gallons of fluid milk products, 3,000 gallons of fruit drinks, 10,000 gallons of frozen desserts, and a small volume of miscellaneous products, such as cottage cheese, shell eggs, butter, and margarine (table 1).

3. To meet normal sales needs, 60 percent of the weekly volume received at the distribution facility from the processing plant is distributed on Wednesday, Thursday, and Friday, and the remaining 40 percent is distributed on Monday, Tuesday, and Saturday. No products are received or distributed on Sunday. Therefore, a larger, daily carryover volume is needed to meet the distribution requirements for Monday.

4. Receipts and distributions are scheduled so that the holdover of finished products does not exceed

Table 1.—*A suggested inventory schedule for handling and storing of 57,000 gallons of fluid milk products and 3,000 gallons of fruit drinks*

Inventory schedule	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	Gallons	*Gallons*	*Gallons*	*Gallons*	*Gallons*	*Gallons*	*Gallons*
Finished products received:							
Fluid milk	7,600	11,400	11,400	11,400	7,600	7,600	0
Fruit drinks	400	600	600	600	400	400	0
Total	8,000	12,000	12,000	12,000	8,000	8,000	0
Finished products distributed:							
Fluid milk	7,600	7,600	11,400	11,400	11,400	7,600	0
Fruit drinks	400	400	600	600	600	400	0
Total	8,000	8,000	12,000	12,000	12,000	8,000	0
Finished product holdover:							
Fluid milk	7,800	11,600	11,600	11,600	7,800	7,800	7,800
Fruit drinks	400	600	600	600	400	400	400
Total	8,200	12,200	12,200	12,200	8,200	8,200	8,200

12,200 gallons. This is 200 gallons more than is needed for daily distribution to compensate for variations in sales. The 12,200 gallons is made up of the following products: Homogenized milk, skim milk, chocolate milk, buttermilk, cream products, and fruit drinks (table 2). To store this variety of products by size of containers, 3,075 16-quart universal cases are required. This is an average of 3.97 gallons per case.

5. The facility will maintain an inventory of 495 cases of miscellaneous products consisting of 250 cases of cottage cheese, 125 cases of shell eggs, 70 cases of butter, and 50 cases of margarine. To maintain the inventory, varying amounts of these products are received from the processing plant or from outside sources. They are distributed as needed along with the fluid milk products and fruit drinks.

6. Of the frozen dessert products stored and distributed by the facility, 75 percent are individual packages of ice cream, ice milk, sherbets, and novelties, and 25 percent are bulk containers. These products are received from the processing plant or from outside sources in amounts sufficient to maintain the 5-day storage inventory of 10,000 gallons to meet minimum distribution requirements. During peak sales months, 2,000 gallons of frozen desserts are distributed daily (5 days a week).

Methods of Receipt

All products (processed, packaged, precooled, or frozen) received at the distribution facility are ready for distribution. Deliveries are programed so that they are received at the distribution facility during slack periods of operation when trucks are not being loaded or unloaded. Fluid milk products, fruit drinks, and most miscellaneous products are transported to the facility in 40-foot-long refrigerated semitrailers, each having a capacity of 800 cases (3,176 gallons). Three such semitrailers are required on Monday, Friday, and Saturday, and four on Tuesday through Thursday (table 1). Two large-volume refrigerated trucks, with 5,000-gallon capacity each, are required to transport the weekly volume of frozen dessert products.

Methods of Distribution

The maximum daily volume of fluid milk products and fruit drinks distributed to the sales outlets by the distribution facility is 12,000 gallons (table 1). Three types of trucks are used to distribute the fluid milk products and fruit drinks, and the miscellaneous products (table 3). About 40 percent of the volume is distributed by eight retail and 10 retail-wholesale combination trucks, while the remaining 60 percent is

Table 2.—Cases required to store the maximum holdover inventory of a variety of fluid milk products and fruit drinks

Product and container	Total volume	Containers per gallon	Total containers	Containers per case	Total cases
	Gallons	*Number*	*Number*	*Number*	*Number*
Homogenized milk:					
Gallon	2,135	1	2,135	4	534
1/2 gallon	4,270	2	8,540	9	949
Quart	854	4	3,416	16	214
Pint	427	8	3,416	28	122
1/2 pint	854	16	13,664	44	311
Skim milk:					
Gallon	183	1	183	4	46
1/2 gallon	1,098	2	2,196	9	244
Quart	549	4	2,196	16	138
Chocolate milk:					
1/2 gallon	30	2	60	9	7
Quart	153	4	612	16	39
Pint	61	8	488	28	18
1/2 pint	366	16	5,856	44	134
Buttermilk:					
1/2 gallon	178	2	356	9	40
Quart	142	4	568	16	36
Pint	18	8	144	28	6
1/2 pint	18	16	288	44	7
Cream products:					
Quart	53	4	212	16	14
Pint	79	8	632	28	23
1/2 pint	132	16	2,112	44	48
Total milk products	11,600	—	—	—	2,930
Fruit drinks:					
Gallon	120	1	120	4	30
1/2 gallon	360	2	720	9	80
Quart	60	4	240	16	15
Pint	30	8	240	28	9
1/2 pint	30	16	480	44	11
Total fruit drinks	600	—	—	—	145
Grand total	12,200	—	—	—	3,075

Table 3.—Type and number of trucks used to distribute the maximum daily volume of fluid milk products and fruit drinks and frozen desserts

Type of truck	Volume per truck[1]		Total volume		Total trucks
	Cases	*Gallons*	*Cases*	*Gallons*	*Number*
Fluid milk products:					
Retail	70	278	536	2,128	8
Retail-wholesale combination	70	278	674	2,676	10
Wholesale	160	635	1,813	7,196	12
Total	---	---	3,023	12,000	30
Frozen dessert products:					
Reach-in ice cream bodies	---	432	---	1,728	4
Combination milk and ice cream	---	34	---	272	([2])
Total	---	---	---	2,000	4
Grand total	---	---	3,023	14,000	34

[1] Volume per truck computed at 80 percent of full load.
[2] 8 retail trucks are considered as combination milk and ice cream trucks.

distributed by 12 wholesale trucks. Based on the assumption that each truck will carry 80 percent of a full load and deliver only one load per day, 30 trucks are required to distribute the total volume of products.

The maximum daily volume of frozen dessert products distributed to sales outlets is 2,000 gallons (table 3). About 86 percent of this volume is distributed by four reach-in ice cream trucks. The remaining 14 percent is distributed with the fluid products on retail trucks.

DESCRIPTION OF DISTRIBUTION FACILITY

The total distribution facility includes a building for receiving, storing, and loading products to be distributed to sales outlets, and supporting installations which consist of a garage, a gas island, parking spaces, and driveways.

Construction and Overall Design

The distribution facility contains about 5,600 square feet of floorspace. The rectangular building is constructed of masonry and steel. The roof is flat and is supported by the walls and steel columns that are located on the docks and loading aprons (fig. 1). The building contains a cooler, a freezer, and a refrigeration equipment room on the first floor and an auxiliary area on the second floor. The layout (fig. 2) shows the arrangement of these areas and the location of equipment in each.

The building is located near the center of a site, which is 250 by 365 feet (fig. 3). The land is reasonably level, but slopes to the outside boundaries for proper drainage. The site, conveniently located in the area served by the distribution facility, has an adequate supply of water, electricity, and sewers all provided by public utility firms. Ample space is provided on the site so that the facility can be expanded to handle a 50-percent increase in volume. The facility is designed to comply with all Government health regulations.

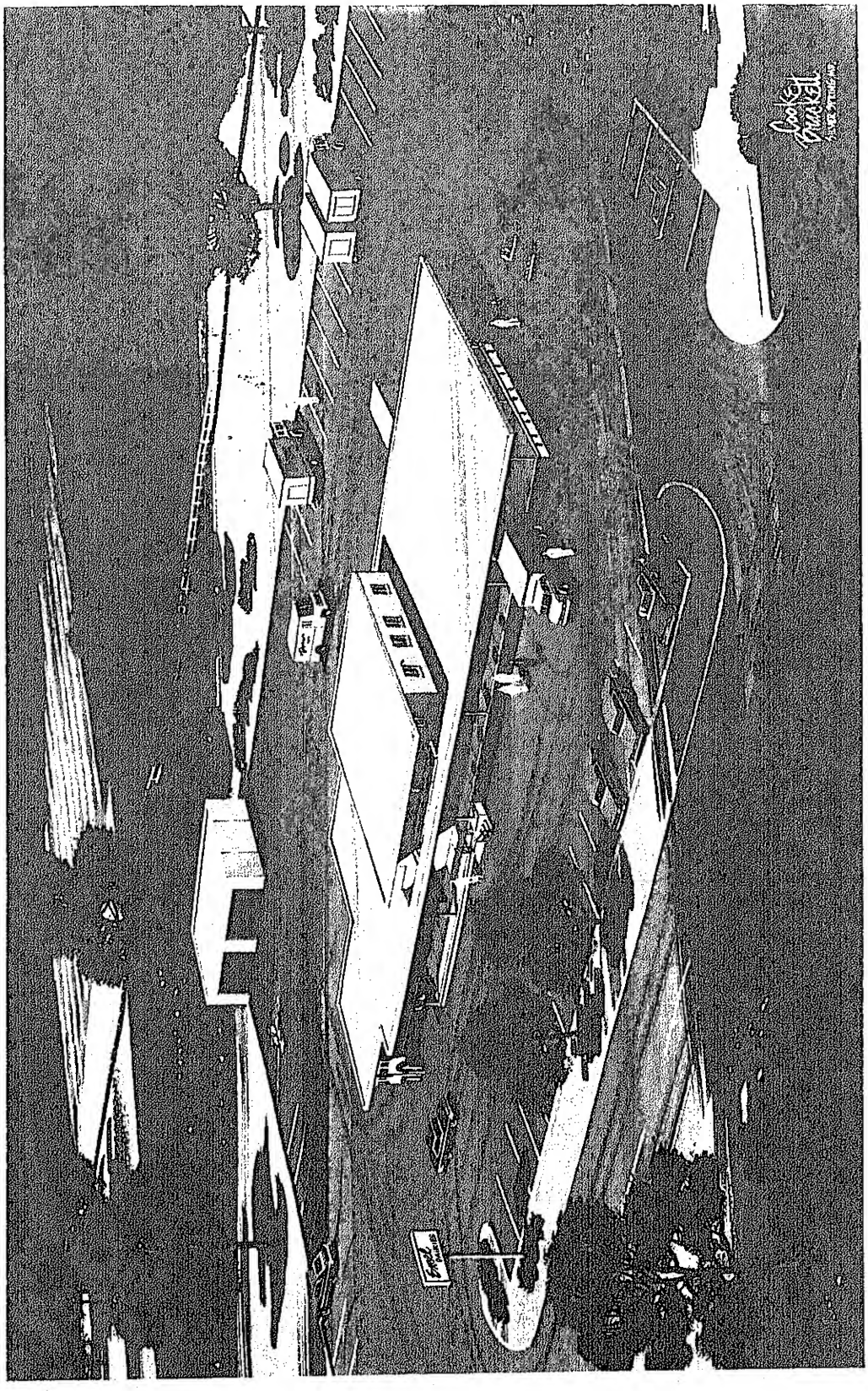

Figure 1.–Prospectus of a dairy products distribution facility.

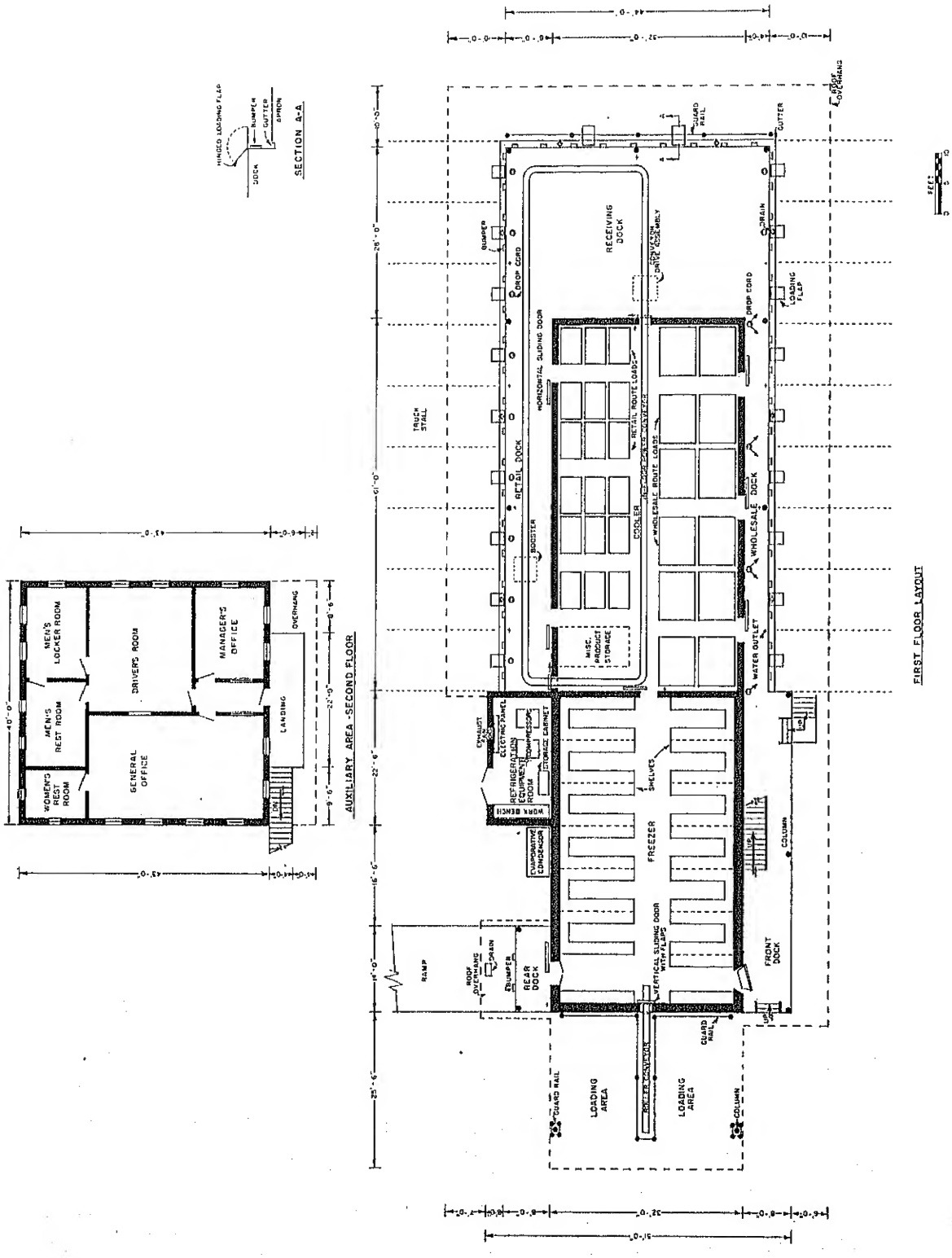

Figure 2.—Layout of dairy products distribution facility.

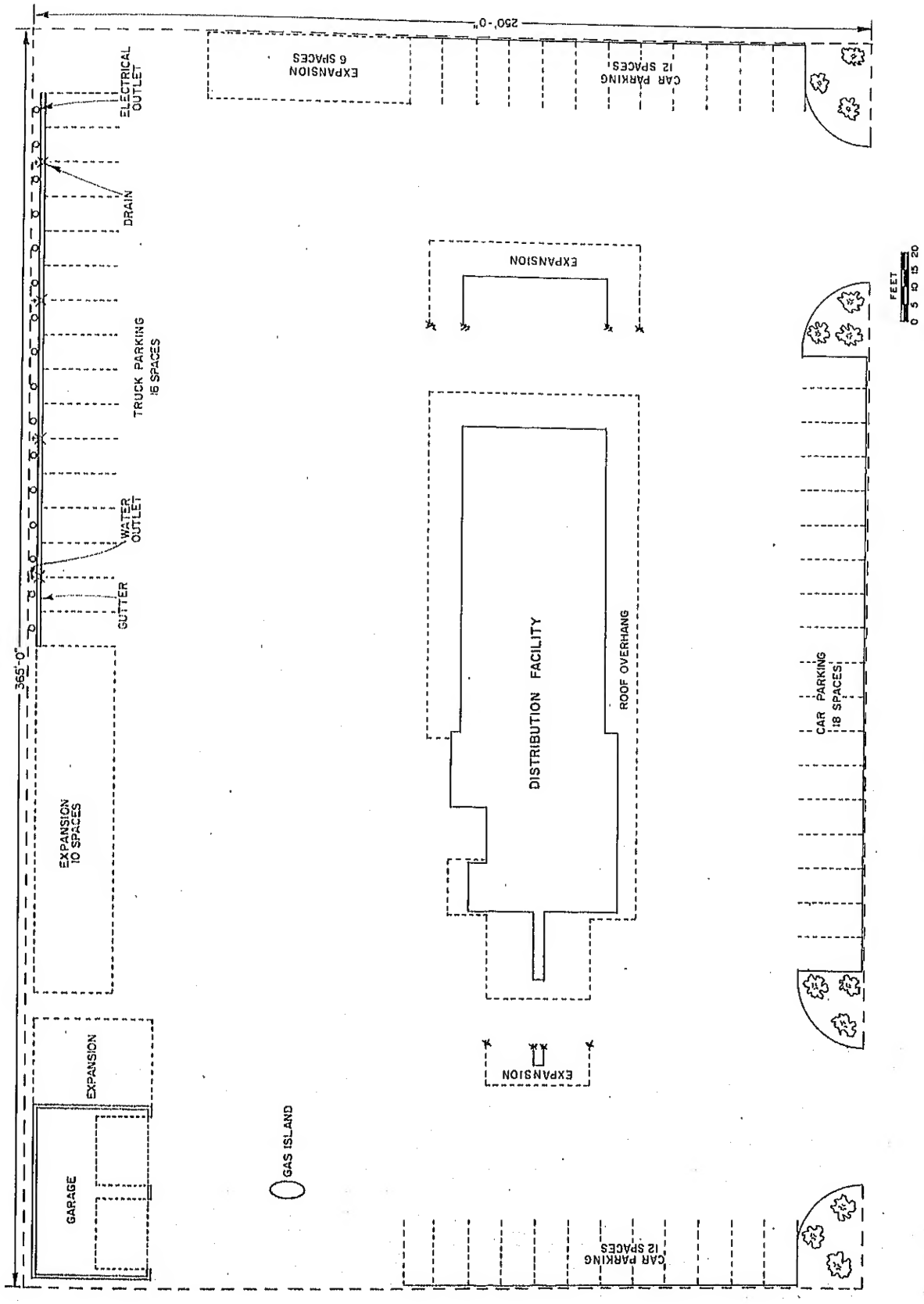

Figure 3.–Site plan for a dairy products distribution facility.

Layout and Operation of the Cooler

The cooler, 30 feet wide and 60 feet long, contains 1,800 square feet of floorspace. Retail route orders are stored on one side of the cooler and wholesale route orders on the other. Space is allocated for storing 18 retail route orders, each consisting of 75 cases, stacked five high. Of these 75 cases, 70 contain fluid milk products and fruit drinks and five contain miscellaneous products. Each retail route order requires floorspace 3½ feet wide by 6 feet long. Route orders are stored six wide and three deep with 3-foot-wide aisles that provide access to the orders. A storage area, 6½ feet wide by 11½ feet long, is reserved for storing 225 cases of miscellaneous products, stacked five high. A 5-foot-wide aisle extends the length of the cooler and provides enough space between the retail and wholesale route orders for an in-floor power conveyor and access to the orders.

Space also is allocated for storing 12 wholesale route orders, each consisting of 175 cases, stacked five high. Of these 175 cases, 160 contain fluid milk products and fruit drinks, and 15 contain miscellaneous products. Each wholesale route order requires floorspace 6 feet wide by 8 feet long. The orders are stored six wide and two deep with 3-foot-wide aisles that provide access for assembling loads. Of the 1,800 square feet of floorspace in the cooler, 865 square feet are used for storing fluid milk products and fruit drinks, 150 square feet for storing miscellaneous products, and 785 square feet for aisles and the conveyor.

The cooler floor covering is diamond-plate steel laid directly on the concrete slab. This provides a durable surface on which to slide stacks of full cases from one point to another. The cooler floor is sloped one-fourth inch per foot for proper drainage. Drainage outlets are located in a trough on each side of the in-floor power conveyor.

The cooler walls and ceiling are smooth finished and water impervious, and they can be cleaned easily. They are insulated to maintain a constant temperature of 36° F. A 12-foot ceiling provides space for proper circulation of refrigerated air above the stacks of cases.

Two cold water outlets inside the cooler have 50-foot-long hoses attached so that water is readily available for cleaning.

Two doorways, each 3 feet wide, provide access from the cooler to the retail dock for the convenience of personnel and for other limited uses, such as unloading the case returns from the retail trucks. Three doorways, each 4 feet wide, provide access from the cooler to the wholesale dock for loading wholesale trucks and unloading case returns. A doorway, 3 feet wide, is located between the cooler and freezer for loading small volumes of frozen desserts onto combination milk and ice cream trucks. Horizontal sliding doors are used, because they require a minimum of space when operated and do not interfere with cooler and dock operations. Two conveyor doors, 2 feet wide and 6½ feet high, equipped with flaps, allow the stacks of cases to pass through the wall on the in-floor power conveyor.

Docks

Three docks adjoin the cooler, a wholesale dock on one side, a retail dock on the other side, and a receiving dock at the end. A roof over the docks extends 10 feet past the edge of the docks and over the aprons to protect the loading and unloading operations during inclement weather. Dock floors are covered with diamond-plate steel so that stacks of cases will slide easily. To avoid traffic congestion caused by the differences in loading time required for large-volume wholesale orders compared with that for small-volume retail orders, separate loading docks are provided for these operations.

The dock used for loading wholesale route trucks is 4 feet wide and 45 inches high—slightly higher than the average truck bed. Stacks of cases are dragged manually from the cooler and along the dock, so that two trucks can be loaded simultaneously from each of the three cooler doors (fig. 2).

The dock used for loading retail route trucks is 8 feet wide and 36 inches high—slightly higher than the average retail route truck bed. The in-floor power conveyor is installed 3 feet from the dock edge and 4 feet from the cooler wall. The 3-foot-wide area is used for holding individual route orders that have been removed from the conveyor. Because the conveyor moves faster than a truck can be loaded, the use of this area allows the conveyor to continue moving, thus eliminating a tieup in the loading operation. The 4-foot-wide area is used for storing empty cases.

The receiving dock is 28 feet wide by 44 feet long and 50 inches high, slightly lower than the average bed height of a semitrailer. It has ample space for storing about 3,100 cases stacked five high. The dock is used for storing empty cases as well as for receiving finished products and for reloading empty cases that are to be returned to the processing plant. A 3-foot-wide area

between the in-floor power conveyor and the edge of the dock is used for unloading and loading semitrailers.

In-floor power conveyor. The in-floor power conveyor is laid out in a rectangle about 204 feet long. The conveyor starts at the point where products are received and extends across the receiving dock, through the cooler, along the retail truck loading dock, and back to the receiving point. The main conveyor drive assembly is located in the receiving dock, and a booster unit is located in the retail truck loading dock. The conveyor has a reversible drive so that it can be operated in either direction. The conveyor is used to (1) unload semitrailers and move products into the cooler for storage, (2) load retail route trucks, and (3) return empty cases to the receiving dock to be stored or reloaded onto semitrailers. The reversible drive feature allows products to be unloaded from semitrailers at the receiving dock, placed on the conveyor, and taken to retail trucks for loading without going through the cooler. This feature also permits products to be moved back and forth in the cooler during the process of making up retail and wholesale route loads. Also, route returns can be moved directly from the cooler to the receiving dock for loading onto semitrailers.

Water outlets. Cold water outlets, which have hoses mounted in retracting units, are provided for washing trucks. The units are attached to and suspended from the ceiling above the edge of the docks so that they are convenient to route drivers. The units are mounted overhead and water hoses are off the floor so as not to interfere with operations on the docks. Each water outlet serves two truck stalls (except for the end stalls which have individual outlets). An outlet also is provided at the end of the receiving dock. A master valve in the cooler controls the water outlets on the docks so that water can be turned off and the pipes drained before freezing weather.

Electrical outlets. Drop cords provide electricity for refrigeration units on those trucks that park overnight alongside the docks. Cords can be retracted so as not to interfere with loading and unloading operations. The retracting units can be suspended from the ceiling along the edge of the docks or attached to the cooler walls.

Bumpers and flaps. To protect vehicles and docks, vertical bumpers, approximately 6 inches thick, 12 inches wide, and 18 inches long, are located on the face of the docks and positioned 4 feet apart at a height corresponding to that of vehicle bumpers.

Plate steel loading flaps are used to bridge the gap between trucks and docks (fig. 2, sec. A-A). These flaps are hinged on steel rods, which are attached to the dock so that they can be adjusted to fit truck doors. When fastened permanently to the docks, the flaps cannot slip and cause accidents. The loading flaps that are used to load the retail and wholesale route trucks are approximately 2 feet wide and 2½ to 3 feet long. Those used for loading refrigerated semitrailers are approximately 2 feet wide and 3 to 3½ feet long. Because the loading docks for retail and wholesale route trucks are slightly higher than the average truck bed, the flaps slope downward from the dock. The receiving dock, however, is slightly lower than the average semitrailer bed, so the loading flaps slope upward from the dock. This makes it easier to slide the stacks of filled cases manually into or out of the trucks.

Aprons

The aprons are hard-surfaced areas that extend 25 feet out from the edge of the docks where trucks are parked while being loaded or unloaded. The aprons slope ¼ inch per foot to a 6-inch-deep and 12-inch-wide gutter that is built along the edge of the docks and encircles the entire cooler dock area. Eight drainage outlets are located in the gutter, three on each side and two at the end of the receiving dock. A 12-inch-high guard rail on the apron at the end of the receiving dock serves as protection during parking of semitrailers alongside the dock.

The stalls for loading and unloading retail and wholesale route trucks are 10 feet wide. This width allows enough space between trucks for movement of personnel, for plugging in refrigeration units, and for performing routine maintenance. Enough stalls are provided so that nine retail and six wholesale route trucks can be loaded simultaneously. Three stalls, located at the end of the wholesale dock and next to the receiving dock, are used for unloading empty cases from wholesale route trucks. These docks contain sufficient space for one-half the total number of trucks loaded each day. The area at the end of the receiving dock is used for unloading or loading one refrigerated semitrailer at a time through its sidedoor, or two refrigerated bobtail trucks at a time through their rear doors.

Stacks of finished products are delivered by semitrailers, placed on the in-floor power conveyor, and moved into the cooler. As products are received in

the cooler, individual route loads are made up and properly positioned for route trucks. After the products have been unloaded from the semitrailers, empty cases that have been stored on the receiving dock are loaded onto semitrailers for return to the processing plant.

Returning wholesale route trucks are parked at the front of the receiving dock in one of three stalls set aside for unloading empty cases. After the empty cases are unloaded, these trucks are moved to a preselected stall alongside the cooler and reloaded. Nine of 12 wholesale route trucks, loaded each day, remain at the dock where retractable drop cords are plugged into their refrigeration units. The other three trucks are parked at the rear of the site where their refrigeration units are plugged into electrical outlets.

Returning retail trucks are parked at the loading dock on a first-come, first-serve basis and empty cases are unloaded. The empties are placed on the in-floor power conveyor and moved to the receiving dock for storing on the dock or for loading onto semitrailers. When the route trucks are ready to be loaded, individual route loads are placed on the conveyor in the cooler and moved to the dock. Trucks are loaded as rapidly as possible and moved to a parking area at the rear of the site where their refrigeration units are connected to electrical outlets. The last nine trucks loaded remain at the dock where their refrigeration units are connected to the retractable drop cords.

Layout and Operation of the Freezer

The freezer is 29 feet wide and 50 feet long with a total floorspace of 1,450 square feet. Shelves are arranged along the walls of the freezer (fig. 2) for storing frozen dessert products. Each stacking area contains shelves—three high, 18 inches apart, and 24 inches wide. This provides a total stacking height of 6 feet. Shelves are constructed of steel frames with heavy gage steel wire which allows the refrigerated air to circulate freely. A 6-foot-wide center aisle extends the entire length of the freezer. Another 6-foot-wide aisle, which extends from the center aisle to the rear dock, is used for receiving products. Three-foot-wide aisles provide access for storing and selecting products. Shelves extend across the end of these aisles, next to the wall, to make efficient use of all available wall space. A total of 4,308 cubic feet of storage space is available on the freezer shelves. If 2.5 gallons of product can be stored per cubic foot, the total storage capacity of the freezer is 10,770 gallons.

The freezer floor, walls, and ceiling are smooth finished and water impervious and can be easily cleaned. They are insulated to maintain a temperature of -20° F. A 12-foot ceiling corresponds with the height of the cooler and provides sufficient space above the stored products for proper circulation of refrigerated air.

A 4-foot-wide doorway, provides access to the rear dock for receiving products. A horizontal sliding door is installed on the doorway because it requires less space on the dock than a door that swings open. Flaps are also installed in the doorway to reduce refrigeration loss. A 3-foot-wide doorway on the front of the freezer provides access to the loading area. A verticle sliding door, 2 feet wide and 2½ feet high, that is equipped with flaps is installed between the freezer and the truck loading area. A section of roller conveyor, 18 inches wide and 24 feet long, is installed permanently through the end wall of the freezer and extends 19½ feet out onto the dock. It is used for moving frozen products to the loading area. The conveyor is attached permanently to the dock apron so that two trucks can be loaded simultaneously through their side-service doors. It is 48 inches above the apron so as to correspond to the height of the trucks' sidedoors. A 2-foot-high guard rail is installed on the apron 6 inches from the freezer wall and the conveyor. This height corresponds with the height of the rear bumpers of the trucks. Guard rails also are installed around the columns that support the roof. The roof over the loading area extends 6 feet past the end of the conveyor for protection from inclement weather and to provide shade.

Docks

Two docks, front and rear, adjoin the freezer. The front dock is an extension of the cooler dock and is 12 inches high and 8 feet wide. It serves as an entrance to the freezer and cooler, as well as to the office area upstairs. The 8-foot width allows enough space for the staircase and for free movement of personnel along the dock. Steps are installed in the dock for convenience of personnel.

The rear dock is 6 feet wide and 14 feet long and is used for the receiving operations. It is designed for unloading only one truck at a time. It is 45 inches

above the ramp to correspond with the average truck bed height of large-volume wholesale trucks. Bumpers along the dock edge protect vehicles and the dock. A steel plate bridges the gap between the truck bed and the dock to aid in unloading the trucks. The roof extends 6 feet past the edge of the dock and over the ramp for protection from weather and for shade. A cold water outlet with a hose attached is provided on the dock for cleaning the receiving and loading areas. A drainage outlet is installed on the ramp for drainage.

The loading area for frozen dessert products includes two stalls, one on each side of the roller conveyor. Each stall is 10 feet wide and 25 feet long. A 3-foot-wide area is provided between the stalls and the conveyor to allow space for the truck drivers to load the trucks.

As products are received, they are transported from the receiving dock and into the freezer where they are manually stacked on the shelves in a predetermined sequence for loading. When the trucks are ready to be loaded, products are selected from the shelves and placed on portable sections of gravity roller conveyors, which are positioned inside the freezer as needed. Thus, products can be moved from any area in the freezer onto the permanently installed conveyor and directly to the dock. Those products that are loaded on the combination milk and ice cream trucks are selected in the freezer and moved through the cooler to the retail truck dock.

Refrigeration Equipment Room

The refrigeration equipment room, 10 feet wide and 20 feet long, contains 200 square feet of floorspace. It is located so as to minimize the distance for piping the refrigeration to the freezer and to the cooler. The equipment includes two compressors, a refrigerant storage tank, an electrical power supply panel, a workbench, and storage cabinets. An evaporative condenser is installed on a concrete slab outside the room.

The floor is at ground level and sloped ¼ inch per foot for proper drainage. The 12-foot ceiling provides ventilation space for dissipating the heat generated by the equipment. Exhaust fans are mounted in the wall near the ceiling for removing the heat from the room. A doorway, 6 feet wide and 8 feet high, provides access for personnel and for moving equipment into or out of the room.

Auxiliary Area, Second Floor

The auxiliary area contains approximately 1,700 square feet of floorspace and a 10-foot high ceiling (fig. 2). This area provides room for a manager's office, a general office, a driver's room, a locker room, and two restrooms. The stairway on the front dock provides access to the area by a 6- by 22-foot landing. The landing is equipped with a safety rail around the outside edges and is covered by a roof to protect the stairway and entrance during inclement weather.

The manager's office and the general office, located at the front of the auxiliary area, are separated by an entrance hallway. The driver's check-in room is designed to accommodate at least 35 route drivers and is located next to the general office. It also serves as an employee welfare area. The entrance hallway provides access to the room and allows the drivers and employees to enter the room without going through the offices. A service window between the general office and the driver's room also permits the drivers to conduct their business without going into the general office.

The restroom and locker room for male employees and route drivers are located next to the driver's room. The restroom for female office employees is located next to the general office. Restrooms are located over the refrigeration equipment room away from the freezer and cooler so as to prevent sanitation problems if plumbing fixtures should leak.

A hot water tank is provided for the restrooms and showers, and wall heaters are used in the auxiliary area. Either window-mounted air conditioners or the main refrigeration equipment used to operate the cooler and freezer can be used to cool it. Floors, exterior walls, and ceilings are insulated to maintain a comfortable temperature and minimize heating and cooling costs.

An intercom system maintains communication between personnel in the offices and those in the cooler and freezer. The system also provides voice contact between personnel in the cooler and freezer and route drivers at the loading docks so that they can request their route loads when ready for loading.

Supporting Installations

Garage

A four-stall garage, 35 feet deep and 50 feet wide, is provided for servicing route trucks and performing

minor repairs. It is located in a corner of the site and away from the major centers of activity (fig.3). The garage is constructed of cement block with a steel supported roof. Overhead doors provide access to individual stalls. Ample space is provided on the site to expand the garage to a width of 75 feet.

Gas Island

A gas island for servicing route trucks is located 35 feet from the front of the garage and 25 feet from the boundary of the site. This location allows enough space to maneuver the trucks and yet is close enough to the garage for the mechanic to service them.

Parking Facilities

Thirty-four parking spaces for trucks are needed at the facility (table 3). Eighteen are located at the cooler dock and 16 are at the rear of the site. The hard-surfaced parking area is 25 feet deep and 160 feet long, and slopes ¼ inch per foot to a gutter drain at the rear of the area. The gutter is 6 inches deep and 12 inches wide, with a drain outlet every 40 feet. A wheel stop is installed on the curb to keep trucks from hitting electrical and water outlets. An electrical unit for each truck's refrigeration unit and water outlets for washing the trucks are located at the rear of the parking area. There are four water outlets, so each outlet would serve four trucks. A master valve is located on the main water line to serve the outlets. The valve is located below ground level so that the lines can be drained and the water shut off during freezing weather. Parking space can be expanded for 10 additional vehicles at the rear of the site between the parking area for trucks and the garage.

Forty-two parking spaces for employees and visitors are provided along the front and on both sides of the distribution facility. These areas are surfaced with crushed rock. Parking space can be expanded for six additional vehicles along the boundary on the cooler side of the site.

Driveways

Buildings and parking areas are arranged on the site to provide sufficient space for driveways and access areas to service any part of the operation. The 40-foot-wide entrance driveways and the driveways that encircle the facility are surfaced with crushed rocks and are sturdy enough to support the weight of the vehicles for which they were intended. The driveways between the ends of the facility and the parking areas for cars are 70 feet wide on one end and 94 feet wide on the other. If the facility is expanded to handle a 50-percent increase in volume, the remaining space still will be sufficient for maneuvering route trucks and semitrailers.

REFRIGERATION REQUIREMENTS

To maintain a temperature of 36° F., the walls in the cooler should be insulated with 3 inches of cork or its equivalent and the ceiling with at least 4 inches of cork or its equivalent. To maintain a temperature of -20° F walls should be insulated with 8 inches of cork or its equivalent and the ceiling with 10 inches of cork or its equivalent. The common wall between the cooler and freezer requires 3 inches of cork or its equivalent. The decision to insulate the floor of the freezer must be made locally. The same applies for determining the need for installing ventilating tiles or heating coils to prevent floor heavage. These decisions should be based on the type, temperature, and moisture content of the ground beneath the floor, as well as the height of the water table in the immediate area.

Based on the insulation thickness and the refrigeration design data that follow, the cooler requires 8 ½ tons of refrigeration and the freezer 5 ½ tons, making a total requirement of 14 tons.

Design temperatures

Outside air	95° F.
Cooler	36° F.
Frozen dessert freezer	-20° F.
Product entering cooler	40° F.
Product entering freezer	0° F.
Maximum time allowed for cooling product in cooler to 36° F.	8 hr.
Maximum time allowed for cooling product in freezer to -20° F.	12 hr.
Specific heat of milk (above freezing)	0.94 B.t.u./lb./°F.
Specific heat of frozen desserts (below freezing)	.45 B.t.u./lb./°F.

A competent refrigeration contractor should be consulted for requirements for specific equipment.

LABOR REQUIREMENTS

Three administrative and three production employees are needed to operate the distribution facility. The manager, one secretary, and one clerk are responsible for directing the facility's operations and conducting administrative business. The production employees are for the cooler, the freezer, and maintenance. The cooler and freezer employees are responsible for receiving the finished products, arranging them in route loads, and placing them on the conveyor for loading. They are also responsible for keeping the facility and surrounding areas clean. The maintenance man is responsible for servicing and performing minor repairs on the route trucks, the refrigeration equipment, and other facility equipment.

COSTS AND POTENTIAL BENEFITS OF A DISTRIBUTION FACILITY

Dairy products processing firms should analyze their own needs to determine the feasibility of building a distribution facility to serve those particular needs. Three major cost factors should always be considered in such an analysis—facility costs, labor costs, and transportation costs.

The total cost of building the distribution facility described in this report is estimated at $125,000,[2] which includes the cost of land, structures, equipment, and paving. This estimated cost will vary in different parts of the country as costs of land and construction fluctuate. A comparison of the costs of the two distribution methods (a facility in the distribution area or distribution facilities at the processing plant) showed that the cost of constructing the facilities could be almost equal. The only difference would be the additional cost incurred by adding those supporting installations to the distribution facility that would not be necessary at the processing plant.

Additional labor would be required in a distribution facility. The facility discussed in this report requires a manager, a secretary, a clerk, two production employees, and a maintenance employee. If some office functions (such as keeping route sales records) were performed at the processing plant instead of at the distribution facility, the need for additional personnel would be eliminated. However, for the labor force anticipated above, the salary and support costs are estimated to be $70,000 a year.

The greatest saving accomplished by the operation of a distribution facility in the distribution area would be in transportation. If products were distributed in a concentrated area 50 miles from the processing plant, the 34 route trucks discussed in this report would be required to travel about 1,000,000 miles annually between the processing plant and the center of the distribution area. If these trucks cost 35 cents per mile to operate, the cost of transportation would be $350,000. If products were hauled from the processing plant to a distribution facility located in the center of the distribution area, larger trucks would be used and would travel only 120,000 miles annually. If these large trucks cost 60 cents a mile to operate, the transportation costs between the processing plant and the distribution facility would be only $72,000—a saving of $278,000 a year.

By subtracting the annual costs of labor, ownership, and operating costs of the additional facilities required from the annual savings in transportation, the net savings brought about by operating through a distribution facility located in the distribution area can be determined.

Some other advantages of the distribution facility described in this report are as follows:

- The use of the facility can expand the market for the output of the processing plant, which, in turn, should permit the plant to take advantage of the economies of scale.
- The facility could be used when an existing processing plant cannot be expanded because of space limitations and when the cost of building a new plant is prohibitive.
- The facility can be expanded easily to fit a specific need without affecting the product flow or operating methods.
- A minimum amount of land is required for the facility because the space above the cooler and freezer is utilized for the auxiliary area.
- The cooler and freezer are joined together by a common wall that reduces construction and refrigeration costs.
- The refrigeration equipment room is located next to the freezer, thereby reducing the installation cost of the refrigeration equipment and minimizing refrigeration loss.

[2] Based on 1972 prices.